HAMMADAH AL HAMRA 119 - A NEW, UNBRECCIATED SAHARAN RUMURUTI CHONDRITE. D. Weber[1], L. Schultz[2], H. W. Weber[2], R. N. Clayton[3], T. K. Mayeda[3], and A. Bischoff[1], [1]Institut für Planetologie, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany, weberd@uni-muenster.de, [2]Max-Planck-Institut für Chemie, 55020 Mainz, Germany, [3]Enrico Fermi Institute, University of Chicago, Chicago, IL 60637, USA.

The meteorite Hammadah al Hamra 119 is a new member of the Rumuruti (R) chondrite group and the third R chondrite found in the Sahara. Based on the find locations and significant differences in petrography and noble gas contents [1,2, 3, this study], a pairing of the three Saharan R chondrites Acfer 217, Dar al Gani 013, and Hammadah al Hamra 119 can be excluded. The meteorite Hammadah al Hamra 119 is unbrec-ciated and can be classified as a R4 chondrite containing equilibrated olivines (~Fa_{38}) and rare Mg-rich olivine.

Introduction: In April 1995 five fragments of an individual meteorite, Hammadah al Hamra 119 (HH119), were collected from the Libyan Sahara (28°30.87'N, 12°53.81'E; total mass: 352g). The Rumuruti (R) chondrite group now comprises eleven meteorites with samples from Kenya (Rumuruti; the only fall), Antarctica (ALH85151, Y-75302, Y-793575, Y-82002, and the paired samples PCA91002 and PCA91241), Australia (Carlisle Lakes), Algeria (Acfer 217), and Libya (Dar al Gani 013, Hammadah al Hamra 119) [4, this work]. In addition to the mentioned meteorites, lithological components were discovered in the Weatherford polymict chondritic breccia which might be R6 clasts [5]. Rumuruti chondrites can be characterized as oxidized, olivine-rich, metal-poor meteorites with a low chondrule/matrix-ratio and high $\Delta^{17}O$ values. Generally, olivines show a high fayalitic component of about $Fa_{37\text{-}40}$ and considerable NiO concentrations on the order of about 0.25 wt%.

Petrography and chemistry: A polished thin section of Hammadah al Hamra 119 (PL 95065) was studied in transmitted and reflected light, by SEM and electron microprobe. This meteorite exhibits an unbrecciated chondritic texture of petrologic type 4. According to the shock classifi-cation system for olivine (and plagioclase) [6], HH119 is weakly shocked (S3) as is suggested by the occurrence of dark shock veins and of planar fractures in olivines. Almost all sulfides and Fe,Ni-metal (if any were originally present) have been destroyed during severe weathering. The high degree (W4) of terrestrial alteration is also indicated by the appearance of silicates usually having a yellow to brown stain.

The mineralogy of HH119 is dominated by olivine. Calcium pyroxene and plagioclase occur as common minerals but are much less abundant than olivine; calcium-poor pyroxene and chromian spinel are present as minor components. Randomly analysed olivines indicate the equilibrated character of the rock by showing a mean Fa content of 37.6 ± 0.3 mol%. In general, olivine in HH119 contains significant amounts of minor elements such as NiO (~0.3 wt%) and MnO (~0.4 wt%). The concentrations of Cr_2O_3 and CaO are below 0.1 wt%. Only one Mg-rich olivine (Fa_{11}) was identified.

Calcium pyroxene has a composition usually close to $Wo_{46}Fs_{10}En_{44}$ and shows characteristic concentrations of Cr_2O_3 and Na_2O (0.6-1.1 wt% and about 0.5 wt%, respectively). However, some grains having a more ferrosilitic composition (~Fs_{17}) were identified. Due to the low modal abundance of calcium-poor pyroxene (similar to Rumuruti and Y-793575 [7,4]) only two measure-ments could be performed revealing Fs-contents of 29.6 and 30.2 mol% and Wo-components of 1.3 and 0.6 mol%, respectively.

Because of the small grain sizes reliable analysis of plagioclase is difficult. However, it seems that most plagioclase is albitic with a peak composition of $Ab_{86}An_9Or_5$. Some of the plagio-clase grains contain significant FeO concentrations (>1 wt%). Anorthite-rich plagioclase as found in Acfer 217 [1] and Y-82002

[8] was not observed. Similar to other R chondrites, chromian spinel in HH119 is characterized by significant amounts of TiO_2 (~5 wt%).

Noble gases: Noble gases were measured in a bulk sample of 105 mg. Hammadah al Hamra 119 does not contain solar gases and its ^{21}Ne-exposure age is 4.6 ± 0.6 Ma. A low cosmogenic $^{3}He/^{21}Ne$ = 2.95 combined with a $^{22}Ne/^{21}Ne$ = 1.109 indi-cates loss of cosmogenic ^{3}He due to solar heating as meteoroid at an orbit with small perihelion distance. The $^{129}Xe/^{132}Xe$ ratio of 1.80 is similar to that of other R chondrites.

Oxygen isotopes: A whole rock analysis of the oxygen isotopic abundances in Hammadah al Hamra 119 reveals that the composition ($\delta^{18}O$ = 6.01, $\delta^{17}O$ = 5.62) is very similar to those of other R chondrites from the Sahara [1,2]. Rumuruti chondrites form an isotopic group well resolved from all other chondrite groups. The difference in oxygen isotopic abundances between R chondrites and ordinary chondrites is larger than differences among the H, L, and LL chondrite groups giving evidence that R chondrites are distinctly different from ordinary chondrites.

Summary and discussion: The chemical composition of the silicates, the chondrule/matrix-ratio, oxygen isotopic composition, and the mineralogy of Hammadah al Hamra 119 with the high modal abundance of olivine and relatively low abundances of calcium pyroxene, feldspar, and calcium-poor pyroxene indicate that this meteorite is classified as a Rumuruti (R) chondrite.

Considering the equilibrated character of olivine and plagioclase in our thin section, Hammada al Hamra 119 should be classified as a R chondrite of petrologic type 4. However, we cannot rule out that in other parts of the bulk rock more forsteritic olivines are present.

Petrographic studies have shown that Hammadah al Hamra 119 and Carlisle Lakes are the only unbrecciated R chondrites [4, this work], both containing well-equilibrated olivines. All other members of the R chondrite group are light/dark-structured breccias and consist of R-clasts of different metamorphic grade (range R3 to R6) embedded in a host of petrologic type 3.6 to 3.9/4. Four of eight measured R chondrites contain solar noble gases (ALH85151, PCA91002/91241, Rumuruti, Acfer 217) and are thus regolith breccias [3,9]. Some exposure ages cluster around 7.5 Ma (Carlisle Lakes, Y-793575, and Dar al Gani 013), a number similar to that of the promi-nent H chondrite cluster. Hammadah al Hamra 119, however, shows the lowest exposure age of all R chondrites investigated so far.

In summary, Hammadah al Hamra 119 can be assigned to the recently established Rumuruti chondrite group. The petrology, mineral chemistry and oxygen isotopic composition of HH119 clearly exhibit the obvious characteristic features of R chondrites but also show the variability in their parent body and irradiation history (i.e. differences in metamorphic grade, in impact-related processes such as shock metamorphism or brecciation, and in concentrations of solar noble gases and cosmo-genic nuclides).

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